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Holographic-Interferometry - the 20th Anniversary

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Guest Editorial

Holographic Interferometry

The Twentieth Anniversary

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This special issue of *Optical Engineering*, which includes the five papers that appeared in the previous (July/August 1985) issue as well as the six papers contained here, commemorates the 20th anniversary of holographic interferometry. As such, it is dedicated to all the known and unknown inventors, coinventors, scientists, researchers, workers, students, and others who have contributed to the development of holographic interferometry.

Although at first holographic interferometry was thought to be the answer to every problem, many of the earliest "holographers" were disenchanted with the lack of success. This was primarily attributed to the unavailability of methods for fringe readout and subsequent quantitative analysis of holographic data. This problem was not trivial, and even today, 20 years later, there is not yet a general method available that can be used reliably to interpret holographic fringe patterns to obtain information on displacements and/or deformations of arbitrary objects. However, a number of methods and systems have been developed for specific applications. The results that have been obtained are very encouraging, and certainly these developments will contribute to the further growth of holographic interferometry.

Rather than review and summarize what was done during the first two decades of work in holographic interferometry, which would be a most formidable task, it was attempted to include in this and the previous issue some of the current work being done in order to illustrate where the field is now. The papers included are representative of the current state of the art of holographic interferometry and are by no means all-inclusive. It is hoped that the papers included in these two issues will, however, give the reader an indication of the variety of applications and forms that holographic interferometry has today.

The method of comparative holography, which allows determination of differences between a master object and an object under test, a feat that was not possible until recently, is presented. Also detailed are the uses of fiber optics to compensate for and measure any motion of arbitrary objects, to remotely measure object deformations through different media, and to record holograms with pulsed lasers. Methods of heterodyne and quasi-heterodyne (step-phase) hologram interferometry are described and illustrated with representative applications ranging from fundamental measurements of structural displacements and contouring, through studies in telecommunications and the automotive industry, to determination of deformations of computer microcomponents. Design, performance characteristics, and selection criteria for pulsed lasers capable of delivering multijoule pulses of holographic quality are reviewed, and new pulsed lasers showing great potential for holographic applications are discussed. Methods of quantitative pulsed laser holography for studies of bone motions and deformations are presented and illustrated with representative examples. The application of time-average holography is discussed in conjunction with finite element studies of vibrating beams. A summary of the current state of the art in automated data reduction of holographic interferograms is given, and operational facilities currently existing in the U.S. are identified. Overall, the papers discuss major aspects of quantitative interpretation of holographic interferograms, beginning with the recording of holograms, through their reconstruction, to information readout and analysis of data.

Many of the applications and systems discussed in these papers became possible only because of the advances in computer and other technologies. It is believed that as new technologies become interfaced with holographic interferometry, it will be used more as a tool or common instrument in many areas rather than only for specialized applications. One thing is certain, however: there will be more and more developments of novel applications of holographic interferometry in the future.

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